Middle Santa Ana River Bacterial Indicator TMDL Agricultural Source Evaluation Plan

PREPARED BY
CDM

ON BEHALF OF
Santa Ana Watershed Project Authority
Milk Producers Council and Chino Watermaster Agricultural Pool

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Table of Contents

List of Figures

List of Tables

Section 1
Introduction

Various waterbodies in the Middle Santa Ana River watershed are listed on the state 303(d) list of impaired waters due to high levels of fecal coliform bacteria. The Middle Santa Ana River (MSAR) Bacterial Indicator Total Maximum Daily Load (TMDL) was adopted by the Santa Ana Regional Water Quality Control Board (RWQCB) and approved by the State Water Resources Control Board (SWRCB) to address these fecal coliform indicator impairments. Environmental Protection Agency (EPA) Region 9 approved the TMDL on May 16, 2007, making the TMDL effective. By November 30, 2007, agricultural dischargers (as defined by the TMDL) are required to submit an Agricultural Source Evaluation Plan (AgSEP). This document is being submitted to fulfill the AgSEP requirement.

1.1 Regulatory Background

Table 3-1 of the Santa Ana Regional Water Quality Control Plan (Basin Plan) designates beneficial uses for surface waters in the Santa Ana River watershed (Santa Ana Regional Water Quality Control Board, 1995). The beneficial uses applicable to waterbodies in the MSAR watershed include Water Contact Recreation (REC-1), which is defined in the Basin Plan as follows:

> "waters are used for recreational activities involving body contact with water where ingestion of water is reasonably possible. These uses may include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, whitewater activities, fishing, and use of natural hot springs" (Basin Plan, page 3-2).

The Basin Plan (Chapter 4) specifies fecal coliform as a bacterial indicator for pathogens ("bacterial indicator"). Fecal coliform present at concentrations above certain thresholds are believed to be an indicator of the presence of fecal pollution and harmful pathogens, thus increasing the risk of gastroenteritis in bathers exposed to the elevated levels. The Basin Plan currently specifies the following water quality objectives for fecal coliform:

REC-1 - *Fecal coliform: log mean less than 200 organisms/100 mL based on five or more samples/30 day period, and not more than 10% of the samples exceed 400 organisms/100 mL for any 30-day period.*

The EPA published new bacteria guidance in 1986 (EPA 1986). This guidance advised that for freshwaters *Escherichia coli* (*E. coli*) is a better bacterial indicator than fecal coliform. Epidemiological studies found that the positive correlation between *E. coli* concentrations and the frequency of gastroenteritis was better than the correlation between fecal coliform concentrations and gastroenteritis.

The RWQCB is currently considering replacing the REC-1 bacteria water quality objectives for fecal coliform with *E. coli* objectives. This evaluation is occurring

through the work of the Stormwater Quality Standards Task Force (SWQSTF). The SWQSTF is comprised of representatives from various stakeholder interests, including the Santa Ana Watershed Protection Authority, the counties of Orange, Riverside, and San Bernardino, Orange County Coastkeeper, Inland Empire Waterkeeper, the RWQCB, and EPA Region 9.

In 1994 and 1998, because of exceedences of the fecal coliform objective established to protect the REC-1 use, the Santa Ana RWQCB added various waterbodies in the MSAR watershed to the state 303(d) list of impaired waters. The MSAR Watershed TMDL Taskforce, which includes representation by many key watershed stakeholders, was subsequently formed to address this impairment through the development of a TMDL for the watershed. The MSAR Bacterial Indicator TMDL addresses bacteria indicator impairments in the following MSAR watershed waterbodies (Figure 1-1):

- Santa Ana River, Reach 3 – Prado Dam to Mission Boulevard in the City of Riverside
- Chino Creek, Reach 1 – Santa Ana River confluence to beginning of hard lined channel south of Los Serranos Road
- Chino Creek, Reach 2 – Beginning of hard lined channel south of Los Serranos Road to confluence with San Antonio Creek
- Mill Creek (Prado Area) – Natural stream from Cucamonga Creek Reach 1 to Prado Basin
- Cucamonga Creek, Reach 1 – Confluence with Mill Creek to 23rd Street in City of Upland
- Prado Park Lake

The TMDL for these waters established compliance targets for both fecal coliform and *E. coli*:

- *Fecal coliform:* 5-sample/30-day Logarithmic Mean less than 180 organisms/100 mL and not more than 10% of the samples exceed 360 organisms/100 mL for any 30-day period.
- *E. coli:* 5-sample/30-day Logarithmic Mean less than 113 organisms/100 mL and not more than 10% of the samples exceed 212 organisms/100 mL for any 30-day period.

1.2 Purpose and Objectives

The MSAR Bacterial Indicator TMDL addresses bacterial indicator impairments by establishing requirements for agricultural and urban dischargers (**Figure 1-2**):

- Agricultural and urban dischargers shall implement a watershed-wide monitoring program;

- Agricultural dischargers shall develop an Agricultural Source Evaluation Plan (AgSEP) and a Bacterial Indicator Agricultural Source Management Plan (BASMP); and

- Permitted Municipal Separate Storm Sewer System (MS4) dischargers shall develop and implement a USEP.

Within the Middle Santa Ana River watershed, agricultural land uses include concentrated animal feeding operations (CAFOs) and irrigated and dry-land farming. Discharges from these agricultural land use areas may include stormwater runoff from manured areas, process wastewater from operations, and tailings from irrigation of agricultural lands. CAFOs are regulated under Waste Discharge Requirements while dry land farming and irrigated farming are not regulated.

The purpose of the AgSEP is to identify specific activities, operations and processes in agricultural areas that contribute bacterial indicators to MSAR watershed waterbodies. The plan includes a proposed schedule for the steps identified and includes contingency provisions as needed to reflect any uncertainty in the proposed steps or schedule.

Information from implementation of the AgSEP will also be used by the RWQCB and agricultural stakeholders to support development of the BASMP. At a minimum, the BASMP shall include, plans and schedules for the following:

(a) Implementation of bacteria indicator controls, BMPs and reduction strategies designed to meet load allocations;

(b) Evaluation of effectiveness of BMPs; and

(c) Development and implementation of compliance monitoring program(s).

Where AgSEP activities identify urban bacterial indicator sources that are not associated with agricultural activities, this information will be provided to the RWQCB for follow-up action.

Given the purpose stated in the TMDL, the objectives of the AgSEP are as follows:

- Establish an Agricultural Operator Database based upon previous data collected from the RWQCB and integration of San Bernardino and Riverside County Assessor Parcel Number data;

- Describe the Agricultural Source Evaluation Monitoring Program to be implemented to identify bacterial indicator sources;

- Describe programmatic activities (site prioritization and source investigation activities) that will potentially be implemented;

- Provide a schedule for AgSEP implementation with contingencies built in to allow for consideration of new data, modified regulations, changing land uses or changing priorities.

1.3 Agricultural Source Evaluation Plan Framework

To fulfill the purpose and objectives stated above, the AgSEP framework consists of three key steps:

- *Step 1: Agricultural Operator Database* – The first step, which is the responsibility of the Santa Ana RWQCB, involves creating an Agricultural Operator Database based upon existing information sources. Section 2 discusses the details of this step.

- *Step 2: Agricultural Source Evaluation Monitoring Program* – The second step in the plan is to conduct a monitoring program at key sites to gather bacterial indicator source data. Section 3 of this plan provides the details of this monitoring program.

- *Step 3: Programmatic Activities* – Step 3 involves implementing a number of activities including site prioritization and source investigation activities such as field surveys, research studies, and controllability assessments.

- *Step 4: Adaptive Implementation* - It is expected that as known facts change (e.g., new data become available or land use changes) or if changes in recreational uses occur on waterbodies as a result of SWQSTF efforts, then site prioritization or the schedule for AgSEP implementation may change. Section 5 describes the adaptive implementation process in the context of the AgSEP schedule.

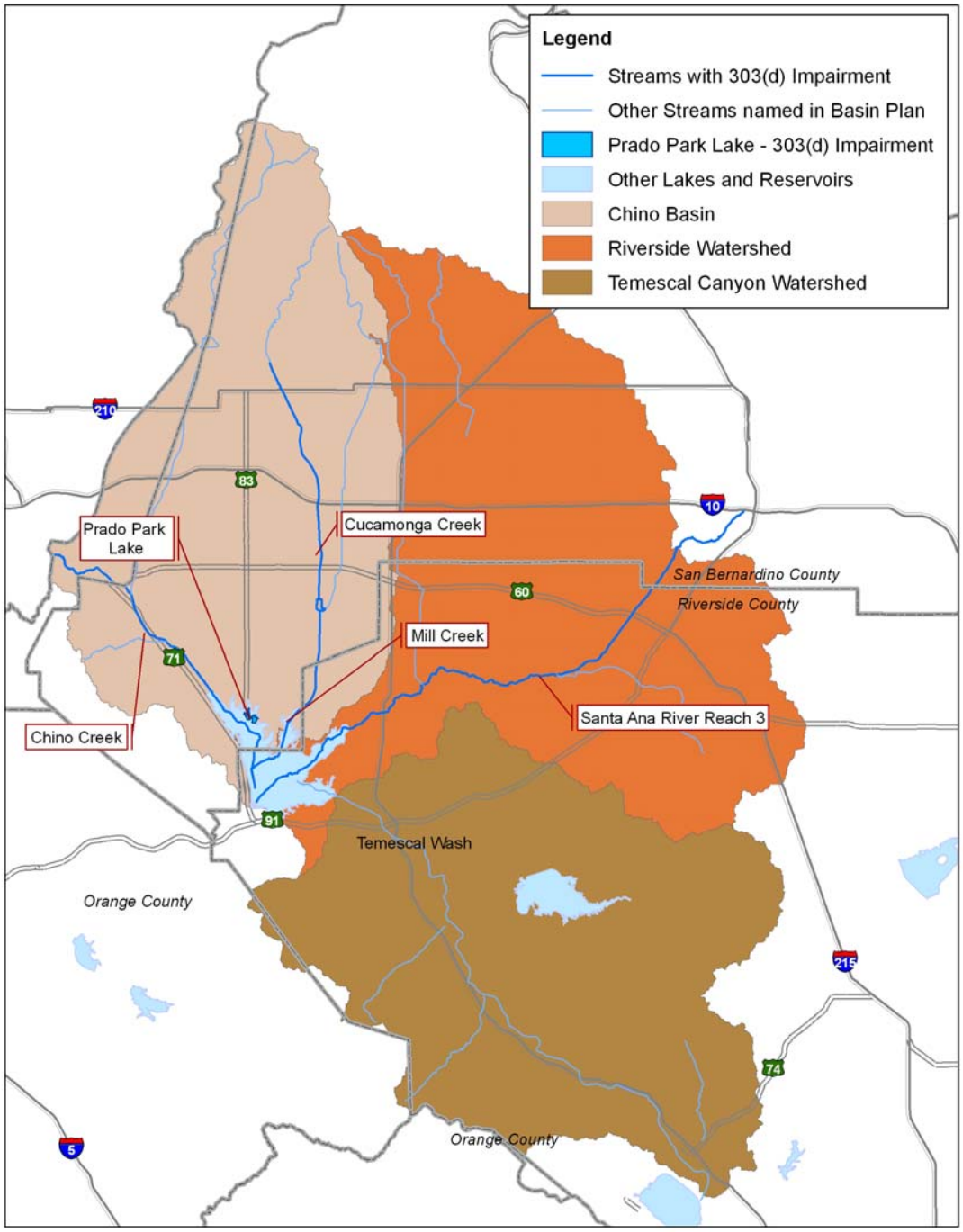


Figure 1-1
Bacterial Indicator Impairments in the MSAR Watershed

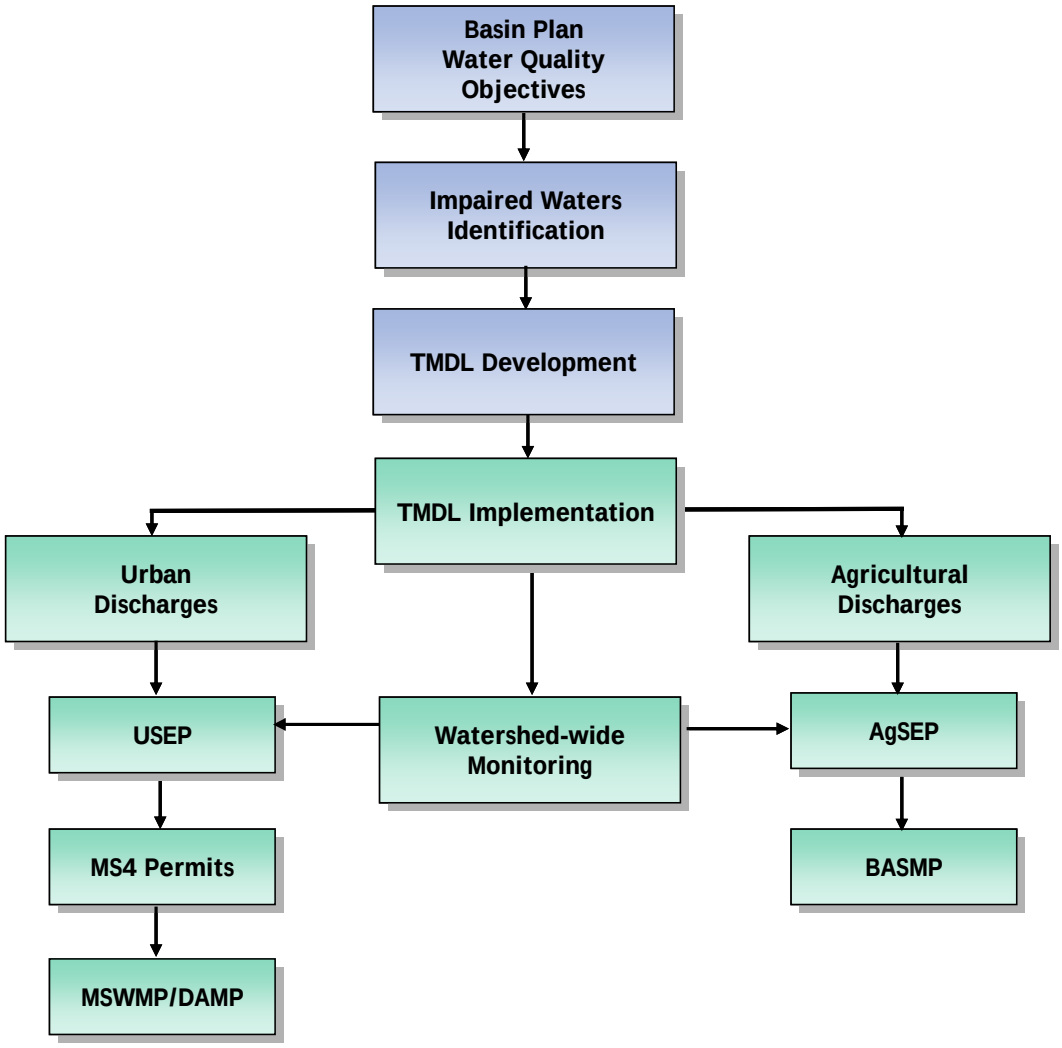


Figure 1-2. Relationship between AgSEP and MSAR Bacterial Indicator TMDL

Section 2
Agricultural Operator Database

A critical first step in determining agricultural bacteria sources is to identify the agricultural owners and operators within the MSAR watershed. Task 2 of the MSAR Bacterial Indicator TMDL indicates that the RWQCB is responsible for identifying these owners and operators. Accordingly, the Santa Ana RWQCB will develop an Agricultural Operator Database from the following data sources:

a) Utilize lists of permitted CAFOs that have Waste Discharge Permits with the RWQCB as the initial basis of information to populate the database.

b) Utilize the RWQCB database of known agricultural owners and operators that has been developed per the requirements of Task 2 of the TMDL.

c) Utilize San Bernardino County and Riverside County property assessor parcel number information for agricultural land use designations. It is understood that the parcel information may not be fully accurate; however, these data provide an important starting point to identify agricultural owners and operators within the MSAR watershed not already identified by other means.

d) Implement process to fill data gaps identified by previous steps or verify information in the database.

Section 3
Agricultural Source Evaluation Monitoring Program

To identify potential agricultural sources of bacteria, a monitoring program will be implemented as a component of the AgSEP. The results of this effort will be an important driver for the implementation of activities to control bacteria indicator sources derived from agricultural discharges. The AgSEP Monitoring Program occurs early in the implementation of the TMDL so that efforts to control sources can be prioritized. The outcome of the AgSEP Monitoring Program will provide data that may tell stakeholders where to focus efforts on implementation of water quality controls and what follow-up studies are needed to narrow the identification of sources.

Elevated levels of indicator bacteria have been documented in most monitored waterbodies within the MSAR watershed; however, the sources of bacteria are unknown. The Agricultural Source Evaluation Monitoring Program has been structured to provide information on bacterial indicator sources in areas where agricultural activities are occurring. However, it is important to note that the uncertainty associated with source identification techniques is relatively high. Accordingly, it is recommended that (1) sources be defined at a fairly high level, e.g., human vs. bovine or non-human bacteria sources, (2) limited to types of analyses where there is a relatively high level of certainty; and (3) that source identification analysis be only one of a number of tools used to identify sources (Rochelle 2007).

For this monitoring program, source identification relies on the use of *Bacteroides thetaiotaomicron* ("*Bacteroides*") markers specific to human and domestic canine sources and *Prevotella ruminiola* for bovine sources. The technical basis for the use of these markers as a source identification tool has been described previously (e.g., EPA 2007; Field and Samadpour 2007; and Kildare et al. 2006).

Bacteroides was selected as the source identification tool for the Urban Source Evaluation Monitoring primarily because it has been successfully used in other regional studies. For example, *Bacteroides* markers for human, domestic canine and bovine sources have been used in water quality studies in the Chino Creek watershed (Leddy 2006) and the Calleguas Creek watershed (Kildare et al. 2006). In addition, the Southern California Coastal Water Research Project (SCCWRP) is currently using *Bacteroides* in its ongoing epidemiologic study of nonpoint source contaminated beaches (SCCWRP 2007).

Rochelle (2007) notes that source identification methods, including *Bacteroides*, should not be the only tool used to assess sources of fecal contamination. This recommendation is based on the recognition that the results of source identification analyses are often not definitive. Accordingly, the source identification data generated by the Agricultural Source Evaluation Monitoring Program will only be used to prioritize resources for follow-up investigations. The types of investigations that may be implemented are discussed in Section 4.

The following sections provide a summary of the monitoring program. Additional details may be obtained from the Monitoring Plan and Quality Assurance Project Plan (QAPP) prepared to support this monitoring effort[1].

3.1 Monitoring Program Framework

Agricultural Source Evaluation Monitoring Program will collect bacterial indicator and source data from four (4) sites during the wet weather season from November 1, 2008 to March 31, 2009. The following data are collected during each sampling event:

- Field Parameters: Flow, temperature, conductivity, pH, dissolved oxygen, and turbidity
- Laboratory Water Quality Parameters: Fecal coliform, *E. coli*, and total suspended solids
- *Bacteroides* Marker Analysis: Samples are assayed for *Bacteroides* host-specific markers for humans, bovine, and domestic canine.

Samples are collected during the wet season under wet weather conditions. Detailed information on field data collection methods, sample frequency and laboratory analysis methods is provided in the Monitoring Plan and Quality Assurance Plan prepared to support the monitoring program[1].

3.2 Monitoring Program Locations

Four sites will be sampled under this monitoring program. In the TMDL, Table 5-9a-a, "Additional Watershed Storm Event Sampling Locations" listed four proposed wet weather sampling locations. Per the Regional Board, the primary reason for the inclusion of these wet weather sites in the TMDL was the need to assess water quality runoff in drains carrying stormwater that originates primarily from agricultural areas (personal communication, William Rice, RWQCB).

These same four sites were considered for inclusion in the AgSEP Monitoring Program. However, after field review and based upon the recommendation of the RWQCB staff, some sample locations were replaced due to increasing urban development within the vicinity of these sites since the development of the TMDL. The newly selected wet weather AgSEP Monitoring sites are summarized in Table 3-1 and shown in Figure 3-1. Included in this site list is a backup location (AG-CL1) to address uncertainty in the nature of the wet weather runoff that occurs at one site (AG-WLK).

[1] *Middle Santa Ana River Monitoring Plan*, August 2007 (or subsequent revisions); *Quality Assurance Project Plan for Middle Santa Ana River Pathogen TMDL Project*, August 2007 (or subsequent revisions)

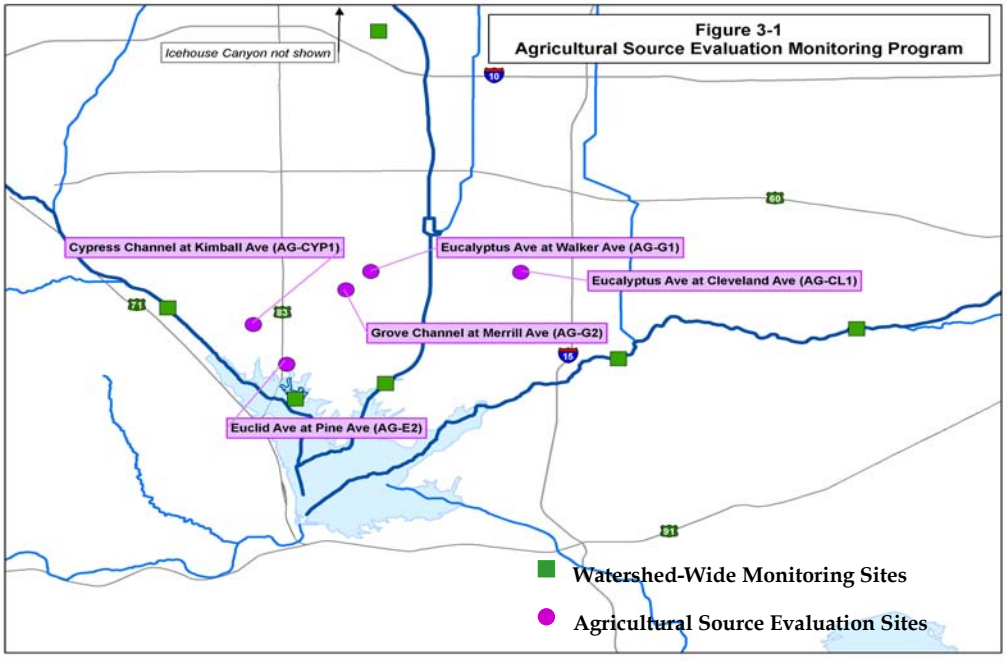
3.3 Monitoring Data Reports

A summary of the data collected through March 2009 will be provided to the TMDL Task Force in April 2009 after all data results become available from laboratories. This submittal will be provided as an electronic spreadsheet file and will not include any data analysis.

A data analysis report that fully evaluates the monitoring data collected from AgSEP sites through March 2009 will be submitted to the TMDL Task Force for review by May 31, 2009. This report will include an evaluation of water quality data in two primary contexts: (1) data patterns and trends observed at the AgSEP sample sites; and (2) observations at the AgSEP sites in the context of other available relevant watershed-wide monitoring data.

Table 3-1 AgSEP Monitoring Program Site Locations

Site ID	Site Description	Latitude	Longitude
Prado Park Lake			
AG-G2	Grove Avenue Channel at Merrill Avenue	33 58.986	-117 37.685
AG-G1	Eucalyptus Avenue at Walker Avenue	33 59.425	-117 37.163
AG-E2	Euclid Avenue Channel at Pine Avenue	33 57.220	-117 38.926
Cucamonga Creek, Reach 1			
AG-CL1	Eucalyptus Avenue at Cleveland Avenue (*Backup to Walker Avenue, depending on flow conditions)* (CL1)	33 59.405	-117 34.031
Chino Creek, Reach 1			
AG-CYP1	Cypress Channel at Kimball Avenue (*dual site; same as USEP site US-CYP*)	-117.66043	33.96888



Section 4
Programmatic Activities

With the completion of Step 1 (Agricultural Operator Database) and Step 2 (Monitoring Program), data will be available to prioritize areas where additional agricultural source investigation and mitigation activities may be necessary. Section 4.1 describes the site prioritization process based on the findings of the Monitoring Program, and Section 4.2 describes the types of follow-up activities that may be implemented.

4.1 Site Prioritization

After water quality data are analyzed from the AgSEP Monitoring Program, sites will be prioritized according to factors such as bacteria indicator concentrations (frequency and magnitude of recorded exceedances), and the data obtained from the *Bacteroides* source analysis. For example, where *Bacteroides* marker analysis indicates the consistent presence of bacteria from bovine sources, agricultural operations located upstream of these sites would be targeted for additional investigation. In cases where a human *Bacteroides* signature is found, these results will be provided to the RWQCB for follow-up action with the urban dischargers. In addition, where bovine sources are identified in drains sampled by urban stormwater dischargers, agricultural operators will work with stormwater dischargers to identify potential sources.

Based on the outcome of the site prioritization effort, one or more follow-up source investigation activities may be implemented, as described below. These efforts will begin with the highest priority sites.

4.2 Source Investigation Activities

For each high priority site, agricultural stakeholders will develop an investigative strategy. This strategy will include an implementation schedule with dates for completion of specific investigative activities. In addition, the strategy will include a schedule for the preparation of progress reports that provide an opportunity to evaluate the data and determine whether any changes to the investigative strategy are warranted. At a minimum, each investigative strategy will be reviewed and, if necessary revised consistent with approved budgets, at least once every six months (see Section 5 and Table 5-1).

Resources will be directed to the high priority areas first, that is, those areas with the most significant problems. Investigative strategies will typically be developed and implemented for moderate and low priority sites only after high priority sites have been addressed. However, when necessary, the priority for any site can be elevated, particularly if new data become available that changes the priority for action.

An investigative strategy will include source investigation activities that fall into at least one of the following three categories: Field surveys; source identification and research studies; and controllability assessments. Within each of these categories, a

menu of investigative tools is available for implementation. Not all tools need be implemented at each high priority site. The following subsections describe the types of investigative tools available. This list of tools is meant to be a list of example tools and is not intended to be an exhaustive list, i.e., where appropriate, stakeholders may consider other tools not described in this section.

Often activities within each of these categories would be implemented sequentially at a given site, e.g., one would first complete additional field survey work before implementing additional source investigations. However, if an understanding of the source problem is well understood, it may be appropriate to skip field surveys and implement additional source investigations or do a controllability assessment.

4.2.1 Field Surveys

Surveys may be conducted upstream of Agricultural Source Monitoring Program sites showing exceedances of bacterial indicators and consistent bovine *Bacteroides* signature in order to better isolate the bacterial indicator sources from agricultural discharges. For these high priority sites, the following steps are examples of what can be implemented in the field. It is important to note that field surveys may have to occur during wet weather conditions to best accomplish survey objectives.

a) Verify that identified upstream operators are properly permitted, (e.g., CAFOs are required to be operating under a WDR); and verify that properly permitted CAFOs are in compliance with all permit requirements.

b) Conduct preliminary source reconnaissance to identify the following activities/issues:

   i. Breach of containment structures (existing Engineered Waste Management Plan (EWMP) requirement for CAFOs) designed to retain wastewater and precipitation (including a 25-year, 24-hour rain event) within the facility

   ii. Establishment of BMPs (berms, etc.) surrounding facilities

   iii. Tracking of manure in and out of facilities

   iv. Overflow of tailwater runoff outside of agricultural operations

   v. Verify/cross check agricultural operations identified in the field surveys with those operations identified in the Agricultural Operator Database

4.2.2 Additional Source Investigations and Research Studies

Within the agricultural lands it may be necessary to conduct additional source tracking activities to narrow down where sources of bacteria are greatest. Such efforts are intended to provide a means to further prioritize implementation of potential control efforts within the agricultural lands. Examples of tools that may be used to support additional source investigations and research studies include:

a) Participating or cooperating in projects to develop additional bacteria source markers such as those for horse markers (if funding available – see further discussion below);

b) Conducting additional source tracking studies upstream of site(s) where hits are observed for bovine markers or other markers as developed in (a);

c) Evaluate relative contribution of bacterial indicators by each flow source – Relating bacterial indicator concentrations to flow sources can help narrow down locations from where the most significant numbers of bacteria are coming from.

4.2.3 Controllability Assessment

Where bacteria sources are clearly identified, a final step in the investigative process is to determine the controllability of the source. Controllability is largely dependent on the nature of the source. For example, for agricultural areas, bacterial indicator sources may be related to agricultural onsite operations, e.g., tracking of manure, breach of containment structures, etc. These sources are likely to be more controllable than non-agricultural sources such as wildlife. In some instances, it may be determined that the source is not controllable. For example, where birds are the primary bacteria source, elimination of birds may not be feasible. In contrast, when the bacterial indicator source is clearly human-derived or related to human activity, then every effort will be made to eliminate the source, e.g., if the bovine bacteria source is a confirmed upstream agricultural operator then appropriate corrective action should be taken.

The controllability assessment will consider three alternatives or factors:

- Prevention (or source control) – Examples include: mitigation of all containment breaches; stronger enforcement of WDRs for CAFOs; implementation of BMPs such as rumble grates at entrances and exits to agricultural operations to lessen tracking manure from facilities; implementation of BMPs for the transport of manure to/from agricultural operations; prevention alternatives to include education initiatives through the Farm Bureau, Natural Resources Conservation Service (NRCS), and the Milk Producers Council.

- Pilot Studies - Seek funding for support of pilot studies or demonstration projects to implement BMPs to control pollutants for agricultural areas. Examples of where funding may be sought include the Clean Water Act Section 319(h) Nonpoint Source Program, NRCS, or Farm Bill program for demonstration projects that seek to control discharges from agricultural discharges;

- Status of Agricultural Operation - With increasing development and urbanization of agricultural land use areas within the MSAR watershed, controllability assessments should consider the longevity of concern. If agricultural areas of concern are located in parcels where redevelopment activities will occur in the near term, then these areas should have lower priority since the agricultural

discharge source ultimately will be eliminated simply due to the conversion of the agricultural land to another land use, e.g., residential or non-agricultural commercial.

Section 5
Implementation

5.1 Adaptive Implementation

Implementation of the MSAR Bacterial Indicator TMDL is a long-term process designed to achieve compliance by 2015 and 2025 for summer dry and winter wet conditions, respectively. Adaptive implementation is an iterative process commonly incorporated into TMDL implementation plans to provide a means to reassess compliance strategies based on new data or analyses. Given the large uncertainty associated with control of pollutants such as bacteria, an adaptive implementation component has been included in the AgSEP framework to provide opportunity, where appropriate, to reconsider priorities. The adaptive implementation process will be conducted per the schedule provided in Table 5-1.

5.2 Agricultural Source Evaluation Plan Schedule

Table 5-1 provides the schedule for implementing the AgSEP. The schedule is initially focused on initiating development of an Agricultural Operator Database and then implementing the Agricultural Source Evaluation Monitoring Program in November 2008 through March 2009. Data summaries will be provided to the RWQCB during the monitoring program. In addition, following completion of this sampling effort, data will be fully analyzed to facilitate initiation of the programmatic activities as described in Section 4, including prioritization of sites for follow-up investigation. Ultimately the information generated by these efforts will support the development of the BASMP.

For sites considered high priority, a site- or sub-watershed-specific implementation strategy will be developed by agricultural stakeholders to the MSAR Watershed TMDL Task Force. Development of this strategy will be completed based on work being conducted under this AgSEP and other work carried out by agricultural stakeholders. Investigative strategies will be developed for high priority sites no later than September 2009. However, if the TMDL Task Force agrees, these strategies may be developed sooner.

Periodically, but at no more than six month intervals,, the stakeholders will consider modifying site investigation activities (including the priority of a given site) through the adaptive implementation process. The AgSEP may be also revised, as appropriate, at this time. In addition, the TMDL Task Force will prepare a status report every six months to provide the RWQCB a summary of ongoing and planned activities related to the management of agricultural sources of bacterial indicators.

Table 5-1. Agricultural Source Evaluation Plan Schedule		
AgSEP Step	**Activity**	**Schedule**
Step 1 – Develop Agricultural Operator Database	Develop database	Responsibility of the Santa Ana RWQCB
Step 2 - Agricultural Source Monitoring Program	Implement sampling program	November 2008 through March 2009 (if wet weather events occur)
	Data summary	April 2009
	Data Analysis Report	May 2009
Step 3 – Programmatic Activities	Prioritize sites for follow-up investigations, as needed	June 2009
	Develop investigative strategy for each high priority site	September 2009 (or sooner, as appropriate)
Step 4 - Adaptive Implementation Process	Prepare status report summarizing ongoing and planned activities related to the management of agricultural sources of bacterial indicators	Every six months, beginning January 2010
	▪ Evaluate progress of and findings from investigative activities ▪ Evaluate new water quality data ▪ Consider changes to regulatory requirements, e.g., permit requirements ▪ Consider changes in land use ▪ Re-prioritize source investigation activities (if needed) ▪ Revise AGSEP (if needed)	Every six months (or more frequently if needed) beginning January 2010

Section 6
References

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